AD A109155

DTIC FILE COPY

PENNSYLVANIA

WILLIAMSBURG STATION DAM

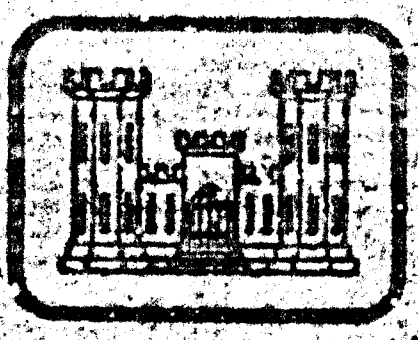
NDI ID NO. PA-540

DER ID NO. 7-48

LEVEL II

PENNSYLVANIA ELECTRIC COMPANY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DTIC
ELECTE
JAN 4 1982
S D
E

R. Jeffrey Kimball

Prepared by

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG, PENNSYLVANIA
15931

structural matrix color plates: All DTIC reproductions will be in black and white

FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

JUNE, 1981

SUSQUEHANNA RIVER BASIN

FRANKSTOWN BRANCH JUNIATA RIVER, BLAIR COUNTY

PENNSYLVANIA

WILLIAMSBURG STATION DAM

NDI ID NO. PA-540

DER ID NO. 7-48

PENNSYLVANIA ELECTRIC COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DACW31-81-C-0016

Prepared By

L. ROBERT KIMBALL & ASSOCIATES

CONSULTING ENGINEERS & ARCHITECTS

EBENSBURG, PENNSYLVANIA

15931

FOR

DEPARTMENT OF THE ARMY

BALTIMORE DISTRICT CORPS OF ENGINEERS

BALTIMORE, MARYLAND

21203

JUNE, 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in detemining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM	Williamsburg Station Dam
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Blair
STREAM	Frankstown Branch of the Juniata River
DATES OF INSPECTION	April 22, 1981 and May 12, 1981
COORDINATES	Lat: 40° 28.3' Long: 78° 12.5'

ASSESSMENT

The assessment of Williamsburg Station Dam is based upon visual observations made at the time of inspection, review of available records and data, hydraulic and hydrologic computations and past operational performance. The inspection and review of data at the Williamsburg Station Dam did not reveal any problems which require emergency action. The dam appears to be in fair condition.

The Williamsburg Station Dam is a high hazard-intermediate size dam. The Spillway Design Flood for a dam of this size and classification is the PMF. The spillway and reservoir are capable of controlling approximately 18% of the PMF. Based on criteria established by the Corps of Engineers, the spillway is termed inadequate.

This dam is a run-of-river type dam with inflow discharging over the spillway. With high discharges the tailwater builds up rapidly causing the weir to become submerged. Downstream flooding normally will result because of runoff in excess of river capacity rather than a result of dam failure. Dam failure at low river flows could result in the loss of more than a few lives in the town of Williamsburg and downstream flooding due primarily to the failure.

The following recommendations and remedial measures should be instituted immediately.

1. The concrete section and toe area should be inspected during periods of low flow in the river to document the actual condition of the section. The inspection of the structure should be conducted by a registered professional engineer knowledgeable in dam design and analysis.

2. The seepage observed at the base of the right concrete retaining wall should be investigated.

3. A planned maintenance and operation schedule should be prepared and implemented at the dam.

4. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

5. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

SUBMITTED BY: L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS

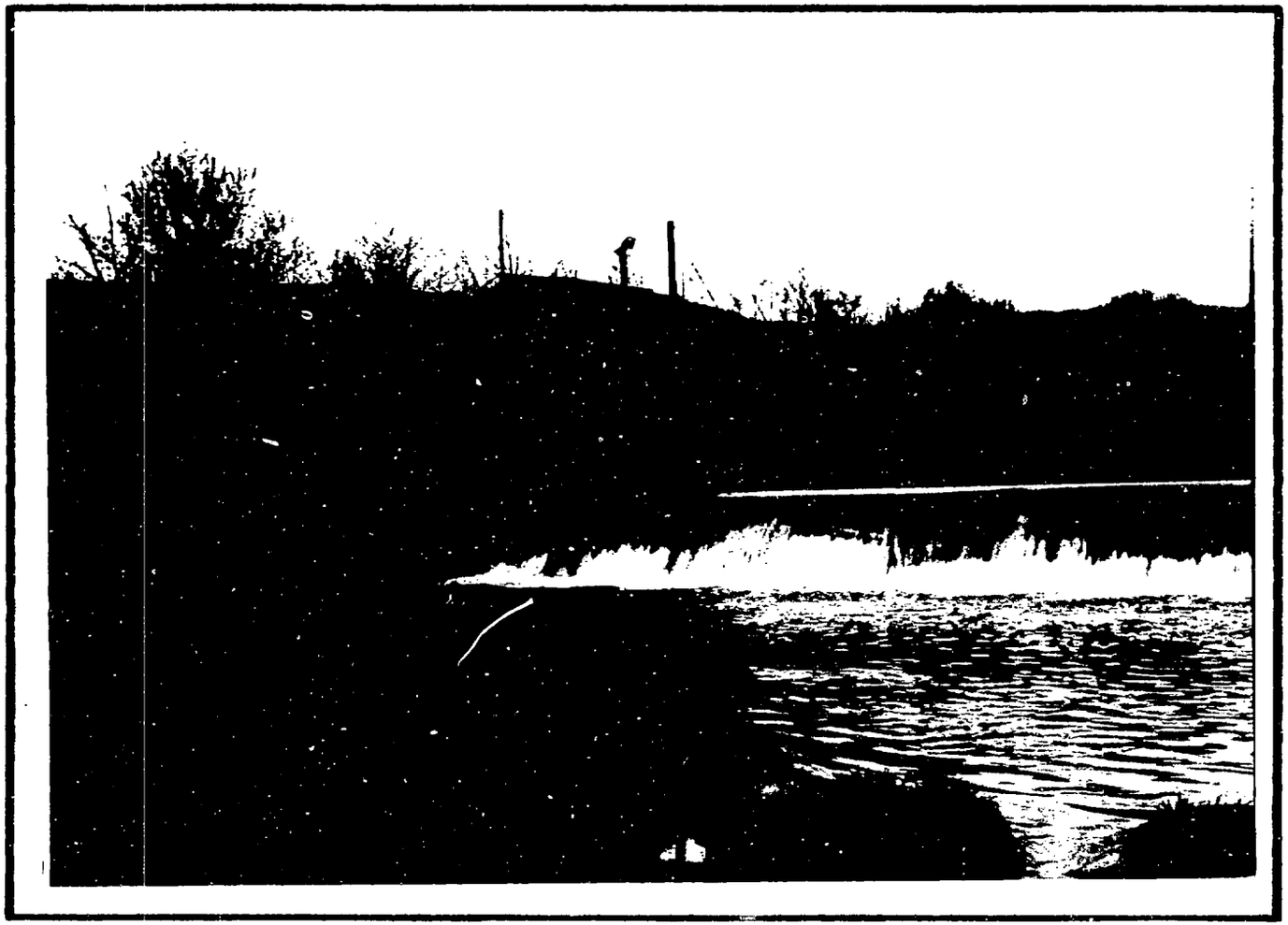
6-15-81
Date

R. Jeffrey Kimball
R. Jeffrey Kimball, P.E.

APPROVED BY:

7 JUL 81
Date

James W. Peck
JAMES W. PECK
Colonel, Corps of Engineers
Commander and District Engineer



Overview of Williamsburg Station Dam.

TABLE OF CONTENTS

APPENDICES

PHASE I
NATIONAL DAM INSPECTION PROGRAM

WILLIAMSBURG STATION DAM
NDI. I.D. NO. PA 540
DER I.D. NO. 7-48

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. The Williamsburg Station Dam is an earthfill dam with a concrete gravity spillway. The dam is approximately 460 feet long and 27 feet high. The earthen section of the dam forms the right abutment of the gravity spillway. Water supply intake facilities exist at the right abutment of the spillway and through the earthen embankment section. The intake facilities supply water to the Williamsburg Power Generating Station, located just south of the dam.

The spillway for the dam consists of a concrete gravity ogee section, with a 260 foot long crest. The gravity section is 15 feet high and concrete retaining walls exist at both ends of the spillway.

The Williamsburg Station Dam is located on the Frankstown Branch of the Juniata River and the spillway is a "run of river" structure.

The right abutment of the spillway is formed by an earthfill embankment. The embankment has been significantly modified since construction of the dam was completed. A concrete corewall exists in the embankment. The corewall extends 120 feet beyond the right spillway retaining wall.

b. Location. The dam is located in Williamsburg, Woodbury Township, Blair County, Pennsylvania. The Williamsburg Station Dam can be located on the Williamsburg, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. The Williamsburg Station Dam is an intermediate size dam (27 feet high, 1000 acre-feet).

d. Hazard Classification. The Williamsburg Station Dam is a high hazard dam. Downstream conditions indicate that loss of more than a few lives is likely in Williamsburg should the structure fail. The town of Williamsburg is located approximately 1 mile downstream of the dam. The Pennsylvania Electric Company (Penelec) Williamsburg Power Generation Station located immediately downstream of the dam.

e. Ownership. The Williamsburg Station Dam is owned by Penelec. Correspondence should be addressed to:

The Pennsylvania Electric Company
1001 Broad Street
Johnstown, Pennsylvania 15907
814/533-8111

f. Purpose of Dam. The purpose of the dam is to provide cooling water to the Williamsburg Power Generating Station.

g. Design and Construction History. Based on limited information contained in the PennDER files, construction of the dam began in mid-1919, and was completed sometime around 1922. The dam was designed and constructed by Day and Zimmerman, Inc., Engineers, of Philadelphia, Pennsylvania.

h. Normal Operating Procedures. Reservoir water is supplied to the Williamsburg Power Station on an as-needed basis.

1.3 Pertinent Data.

a. Drainage Area.

	312 square miles (measured)
	291 square miles (U.S.G.S.)

b. Discharge at Dam Site (cfs).

Maximum flood at dam site (June, 1889)	35,500 est. U.S.G.S.
Spillway capacity at top of dam	41070

c. Elevation (M.S.L.) (feet). - Field survey based on spillway crest elevation 848.0 feet obtained from design drawings.

Top of dam - low point	860.0
Top of dam - design height	860.0
Maximum pool - design surcharge	860.0
Normal pool	848.0
Spillway crest	848.0
Upstream portal - 48" diameter cast iron pipe	836.0
Downstream portal - 48" diameter cast iron pipe	836.0
Streambed at centerline of dam (approximate)	834.5
Maximum tailwater	Unknown
Toe of dam	833.0

d. Reservoir (feet).

Length of maximum pool	16000
Length of normal pool	7000

e. Storage (acre-feet).

Normal pool	199
Top of dam	1001

f. Reservoir Surface (acres).

Top of dam	90
Normal pool	46
Spillway crest	46

g. Dam.

Type	Earthfill with concrete gravity spillway
Length	460 feet
Height	27 feet
Top width	>200 feet
Side slopes - upstream	Vertical
- downstream	Not applicable
Zoning	Unknown
Impervious core	Concrete
Cutoff	Yes
Grout curtain	None

h. Reservoir Drain.

Type	(2) 48" diameter cast iron pipes
Length	10 feet
Closure	Gate valves on upstream face of ogee section
Access	None
Regulating facilities	Gate valves

i. Spillway.

Type	Concrete gravity ogee section
Length of crest	260 feet
Crest elevation	848.0
Upstream channel	Frankstown Branch of Juniata River
Downstream channel	Frankstown Branch of Juniata River

SECTION 2
ENGINEERING DATA

2.1 Design. Review of available information in the files of the Commonwealth of Pennsylvania, Department of Environmental Resources, revealed that some correspondence, permit information and limited detailed drawings of the dam were available for review. All information was reviewed for this study. Penelec was unable to provide any additional information.

2.2 Construction. The Williamsburg Station Dam was constructed around 1919. References to brief inspections during construction exist in the DER file.

2.3 Operation. Water is drawn from the reservoir for cooling purposes at the Williamsburg Power Generating Station.

2.4 Evaluation.

a. Availability. Engineering data were supplied by the Pennsylvania Department of Environmental Resources, Bureau of Dams and Waterway Management. A representative of Penelec, Mr. Richard T. Gallus, accompanied the inspection team and was interviewed in regards to the operation and maintenance of the dam.

b. Adequacy. This Phase I Report is based on the visual inspection, hydrologic and hydraulic analysis, and available data. Sufficient information exists to complete a Phase I Report.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Williamsburg Station Dam was conducted by personnel of L. Robert Kimball and Associates on April 22, 1981 and May 12, 1981. Mr. Richard T. Gallus accompanied the inspection team during the April 22, 1981 inspection of the dam. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portion of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appears to be in fair condition. From a brief survey conducted during the inspection, it was noted that the crest of the dam was relatively consistent with the top of the right spillway wingwall. The earthen embankment section is utilized as a storage area for equipment utilized at the plant. The embankment has been significantly modified since construction, but no date is associated with the modifications. The design of the earthen embankment section incorporated an approximately 200 foot long earthen embankment section. The top width of the embankment was 12 feet, and the slopes were 2H:1V. It was observed that the area had apparently been filled and the original construction was not distinguishable. The elevation of the crest, to the right of the spillway, is relatively consistent along the right bank of the river extending to the area of the power generating station.

c. Appurtenant Structures. The spillway for the Williamsburg Station Dam consists of a concrete ogee gravity section. The crest length of the section is 260 feet. Vertical concrete walls exist at either abutment of the spillway. The natural ground above the left abutment retaining wall is relatively flat for a distance of approximately 10 feet, at which point a near vertical rock outcrop exists.

During the April 22, 1981 inspection, a depth of flow across the crest of the spillway was measured to be approximately 6 inches. The depth of flow during the May 12, 1981 inspection was approxiamtely 1 foot. The condition of the weir could not be determined due to the flow over the gravity section. The tailwater during the April 22, 1981 inspection was significantly less than that observed during the May 12, 1981 inspection. During the April 22nd inspection, some minor

seepage was observed near the base of the right spillway retaining wall. Seepage at this time was estimated at 1 to 2 gallons per minute. The seepage area was not visible during the May 12th inspection, due to the increased tailwater depth. The concrete retaining walls at either end of the ogee section showed signs of deterioration. No visible cracks were observed in these structures.

The intake facility for the water supply line to the plant is adjacent to the right spillway retaining wall on the earthen section. Based on information from the design drawings, the original intake structure was abandoned in lieu of a second structure completed at some later date. The present facilities consist of a screen chamber on the earthen embankment section adjacent to the right spillway retaining wall. Water from the screen chamber is transported to the plant through two 48" cast iron pipes. It appears as though the lines also supply water to the spray pond at the power plant.

An abandoned intake line exists along the right bank of the river, just upstream of the dam. The abandoned line was utilized at one time to draw water from the river at a point upstream of the dam.

d. Reservoir Area. The reservoir slopes are moderate to steep and do not appear to be susceptible to massive landslides which would affect the storage volume of the reservoir.

e. Downstream Channel. The downstream channel of the Williamsburg Station Dam is relatively wide to the Borough of Williamsburg. Along the north edge of town, the river abruptly changes course and flows to the north of the community.

3.2 Evaluation. The earthen section of the dam to the right of the spillway section appeared to be in good condition. The crest of the embankment section is significantly broad and not readily susceptible to normal seepage and structural problems.

The concrete gravity section was not clearly visible due to flow over the structure during the inspections. No determination could be made as to the condition of the section. The concrete retaining walls appeared to be in fair condition. A small seepage area was observed at the base of the right spillway retaining wall. The condition of the gravity section could not be determined due to the flow over the spillway crest.

The ogee section and the toe of the structure should be closely inspected during a period of low flow in the river.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. Water is drawn from the reservoir on an as-needed basis. The dam is used to supply water to the Williamsburg Power Station.

4.2 Maintenance of the Dam. No planned maintenance schedule exists for the Williamsburg Station Dam. Maintenance of the dam is conducted on an unscheduled, as-needed basis.

4.3 Maintenance of Operating Facilities. No planned maintenance schedule exists for the operating facilities. Maintenance of the operating facilities is completed on an unscheduled, as-needed basis.

4.4 Warning System in Effect. There is no warning system in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

4.5 Evaluation. The condition of the Williamsburg Station Dam is considered fair. There was no warning system in effect to warn downtream residents at the time of inspection. An emergency action plan should be available for every dam in the high and significant hazard category. Such action plans should outline actions to be taken by the operator to minimize downstream effects of an emergency, and should include an effective warning system. An emergency action plan has not been developed; the owner should develop such an action plan.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. Only limited information was available in the DER files relative to the design of the spillway. Available information indicates that the spillway was designed to handle in excess of 93 cfs per square mile (28,000 cfs) when considering the drainage area. Information in the DER files suggest that a margin of 3 feet between the water surface elevation and the top of the earthen embankment was associated with the design flow.

b. Experience Data. No rainfall, runoff or reservoir level data were available. A U.S.G.S. gaging station is located downstream of the dam, in the Borough of Williamsburg. A high water mark exists on the gaging station structure. The high water mark is associated with a June 1889 flood.

c. Visual Observations. The spillway appeared to be in fair condition. A close inspection of the structure could not be made due to flow over the structure. No obstructions were observed in the area of the spillway which were considered as being capable of affecting the discharge potential of the spillway.

The top of dam was considered to be the elevation at the top of the right spillway retaining wall.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July 1978. The major methodologies or key input data for this program are discussed briefly in Appendix D.

5.2 Evaluation Assumptions. To enable completion of the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. The pool elevation prior to the storm was assumed to be at the spillway crest elevation, 840.0.

2. The top of dam was considered to be the elevation at the top of the right spillway retaining wall, elevation 860.0.

3. No upstream dams were considered during the analysis.

5.3 Summary of Overtopping Analysis. Complete summary sheets for the computer output are presented in Appendix D.

Peak inflow (PMF)	223,700 cfs
Spillway capacity	41,070 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) for a dam of this size and classification is the PMF. Based on the following definition provided by the Corps of Engineers, the spillway is rated as inadequate as a result of our hydrologic analysis.

> Inadequate - All high hazard dams which do not pass the Spillway Design Flood (SDF).

The spillway and reservoir are capable of controlling approximately 18% of the PMF without overtopping the embankment.

5.4 Summary of Dam Breach Analysis. A dam breach analysis and downstream routing of the flood was not performed for this structure. The purpose of such an analysis is to determine if the downstream potential for loss of life and property damage is significantly increased by dam failure. During an extreme hydrometeorological event the weir would be submerged; and if failure of the structure would occur, no appreciable increase would be noted downstream. Since the stability of the structure appears to meet current criteria for static stability, and since the dam is considered capable of passing at least 1/2 the PMF without failure, no dam breach analysis and downstream routing of the flood wave was conducted.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. No major deficiencies were observed during the inspection. No major erosion areas were observed on the earthen embankment section or in the area of the ogee section. Flow over the crest of the spillway hampered attempts at close visual inspection of the structure. Only minor seepage was observed during the April 22, 1981 inspection. The seepage was observed at the base of the right spillway retaining wall and seepage was estimated at 1 to 2 gallons per minute. The concrete in the spillway retaining walls showed some signs of deterioration but no major cracking was observed.

b. Design and Construction Data. Only limited information regarding the design of the concrete gravity section and earthen embankment section were available in the DER files. No construction data were available for review. A section drawing of the spillway is located in the DER files and was utilized in the static stability analysis calculations. The cross-section drawing is located in Appendix E of this report.

c. Operating Records. No operating records are maintained at the Williamsburg Station Dam. Water is drawn from the reservoir for use in the plant on an unscheduled, as-needed basis.

d. Post Construction Changes. The earthen embankment section to the right of the concrete spillway has apparently undergone extensive modification since the dam was constructed. No known date is associated with the modifications. The entire right earthen embankment section was filled to an elevation relatively consistent with the elevation of the plant. An addition to the Williamsburg Station Dam was completed sometime around 1944 and the modifications to the earthen embankment section may have occurred as part of the expansion project.

e. Stability Analysis. An approximate analysis of the static stability of the gravity spillway section was performed for this study. During periods of extreme hydrometeorological events, the weir would be quickly submerged and no stability analysis during this condition was considered necessary.

f. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analyses have been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading. Based on the results of the stability analysis contained in Appendix G, the factor of safety, under static loading conditions, appears to be within minimum accepted criteria.

The analysis revealed that the dam is stable under static loading conditions. A factor of safety equal to 1.5 (sliding) and 2.2 (overturning) resulted from the analysis. The resultant was determined to fall within the middle third of the base of the section. The stability analysis calculations appear in Appendix G of this report.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The dam appears to be in fair condition. No obvious signs of instability were observed on the concrete gravity section. A close inspection of the structure was not possible due to flow over the structure. The concrete gravity section should be inspected during periods of low flow in the river. The concrete for the spillway retaining walls shows signs of deterioration and a small seepage area was observed at the base of the right concrete retaining wall. Seepage in the area was estimated at 1 to 2 gallons per minute during the April 22, 1981 inspection. No examination of the seepage area could be made during the May 12, 1981 inspection due to an increased tailwater at the time of inspection. The Williamsburg Station Dam is a high hazard-intermediate size dam. The Spillway Design Flood for a dam of this size and classification is the PMF. The visual observations, review of available data, hydrologic and hydraulic calculations and past operational performance indicate that the Williamsburg Station Dam is capable of controlling approximately 18% of the PMF without overtopping the earthen embankment section. The spillway is classified as inadequate.

This dam is a run-of-river type dam with inflow discharging over the spillway. With high discharges the tailwater builds up rapidly, causing the weir to become submerged. Downstream flooding normally will result because of runoff in excess of river capacity rather than a result of dam failure. Dam failure at low river flows could result in downstream flooding due primarily to the failure.

b. Adequacy of Information. Sufficient information is available to complete a Phase I report.

c. Urgency. The recommendations suggested below should be implemented immediately.

d. Necessity for Further Investigation. No further investigations are required.

7.2 Recommendations/Remedial Measures.

1. The concrete section and toe area should be inspected during periods of low flow in the river to document the actual condition of the section. The inspection of the structure should be conducted by a registered professional engineer knowledgeable in dam design and analysis.

2. The seepage observed at the base of the right concrete retaining wall should be investigated.

3. A planned maintenance and operation schedule should be prepared and implemented at the dam.

4. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

5. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

APPENDIX A
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Williamsburg Station Dam COUNTY Blair STATE Pennsylvania ID# PA 540

TYPE OF DAM Earthfill with concrete gravity spillway HAZARD CATEGORY High

DATE(s) INSPECTION April 22, 1981 May 12, 1981 WEATHER 4/22/81 Clear and warm TEMPERATURE 60° - 4/22/81

POOL ELEVATION AT TIME OF INSPECTION 848.6 M.S.L. 4/22/81 TAILWATER AT TIME OF INSPECTION 839.0 M.S.L. 4/22/81

A-1

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E. - L. Robert Kimball and Associates

James T. Hockensmith - L. Robert Kimball and Associates

O.T. McConnell - L. Robert Kimball and Associates

Richard T. Gallus - Pennsylvania Electric Company

O.T. McConnell RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Appears to be all right.	
RIPRAP FAILURES	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Not applicable.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appears to be all right.	
ANY NOTICEABLE SEEPAGE	None.	
STAFF GAUGE AND RECORDER	None.	A U.S.G.S. gaging station exists downstream of the dam in the Borough of Williamsburg.
DRAINS	None.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Minor seepage was observed at the base of the right concrete retaining wall for the spillway.	The seepage should be investigated.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Appears to be all right.	
DRAINS	None.	
WATER PASSAGES	No problems reported.	
FOUNDATION	Unknown.	Information in the DER files suggest that the ogee section is founded on limestone.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	The concrete retaining walls for the spillway show some signs of deterioration.	
STRUCTURAL CRACKING	None observed.	The ogee section should be inspected during a period of low flow in the river.
VERTICAL AND HORIZONTAL ALIGNMENT	Appear to be all right.	
MONOLITH JOINTS	A close inspection of the concrete section could not be made due to flow over the structure.	
CONSTRUCTION JOINTS	Not observed.	
STAFF GAUGE OR RECORDER	None.	A U.S.G.S. gaging station exist downstream of the dam in Borough of Williamsburg.

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not applicable.	
INTAKE STRUCTURE	Screen chamber at right abutment.	
OUTLET STRUCTURE	Not applicable.	
OUTLET CHANNEL	Not applicable.	
EMERGENCY GATE	Not applicable.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Concrete ogee section. The condition of the weir could not be determined due to flow over the structure.	The section should be inspected by qualified personnel during periods low flow in the river.
APPROACH CHANNEL	Unrestricted.	
DISCHARGE CHANNEL	Frankstown Branch of the Juniata River.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable.	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

DOWNSTREAM CHANNEL

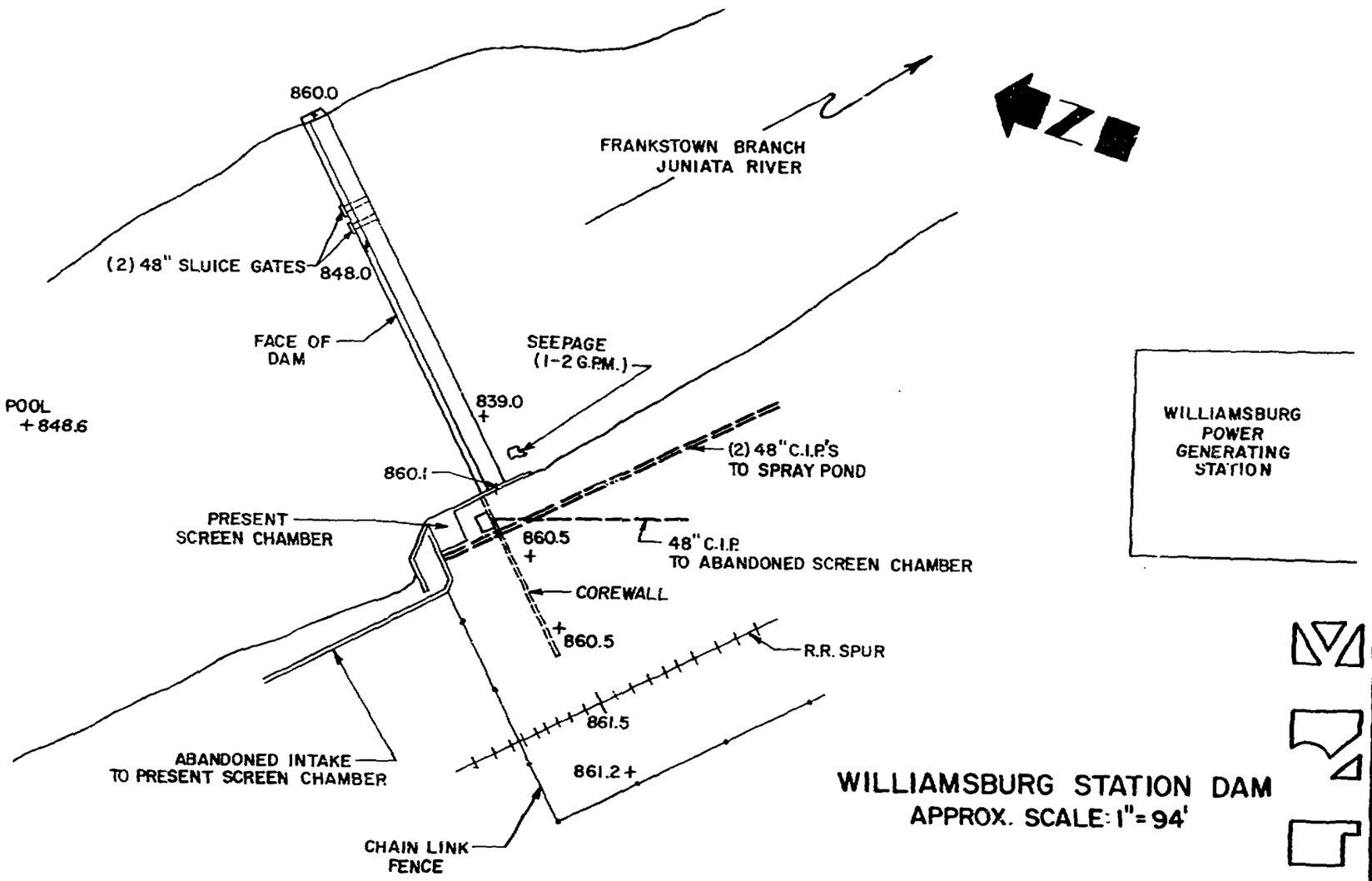
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel for the Williamsburg Station Dam consists of the Frankstown Branch of the Juniata River. No major obstructions were observed.	
SLOPES	Appear to be stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	The Borough of Williamsburg is located immediately downstream of the dam. A population of the Borough is estimated at 1,000 people.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderate to steep. Appear to be stable.	
SEDIMENTATION	Unknown.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	



WILLIAMSBURG STATION DAM
APPROX. SCALE: 1" = 94'

A-12

APPENDIX B
CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION, PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Williamsburg Station Dam

ID# PA 540

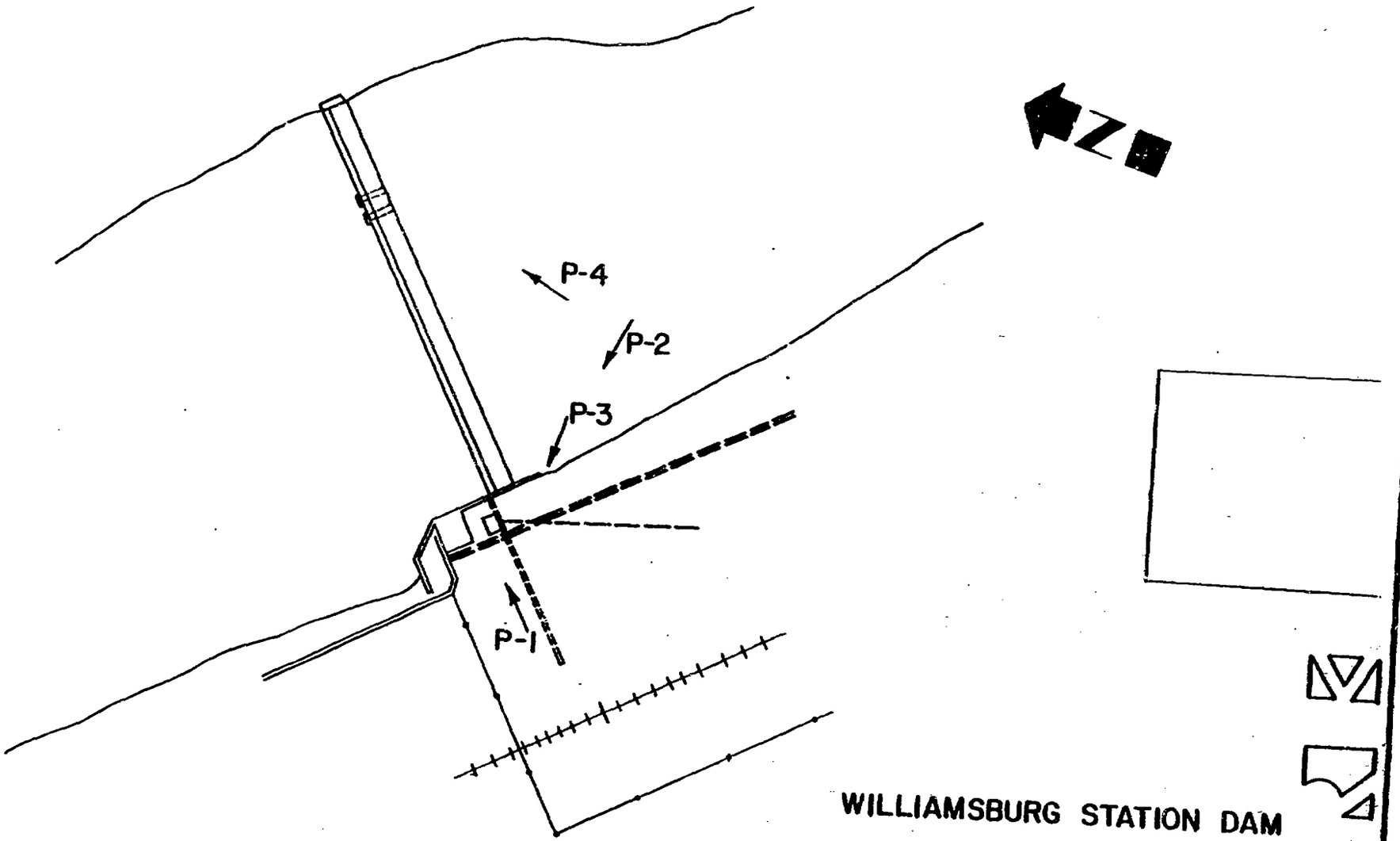
ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. quadrangle.
CONSTRUCTION HISTORY	None.
TYPICAL SECTIONS OF DAM	See Appendix E.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	See Appendix E. See Appendix E. See Appendix E. None. None.

ITEM	REMARKS
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None. Limited test pit data in Appendix E. None.
POST-CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Major modifications occurred to the right earthen embankment section. No date is associated with the modifications.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None known to exist.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	See Appendix E.
OPERATING EQUIPMENT PLANS & DETAILS	See Appendix E.

APPENDIX C
PHOTOGRAPHS



C-1

WILLIAMSBURG STATION DAM
PA 540

Sheet 1

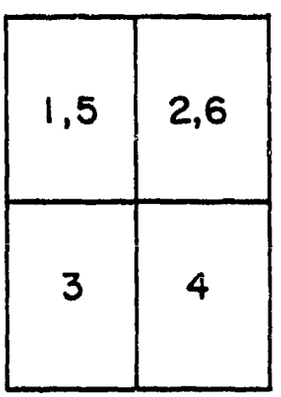
Front

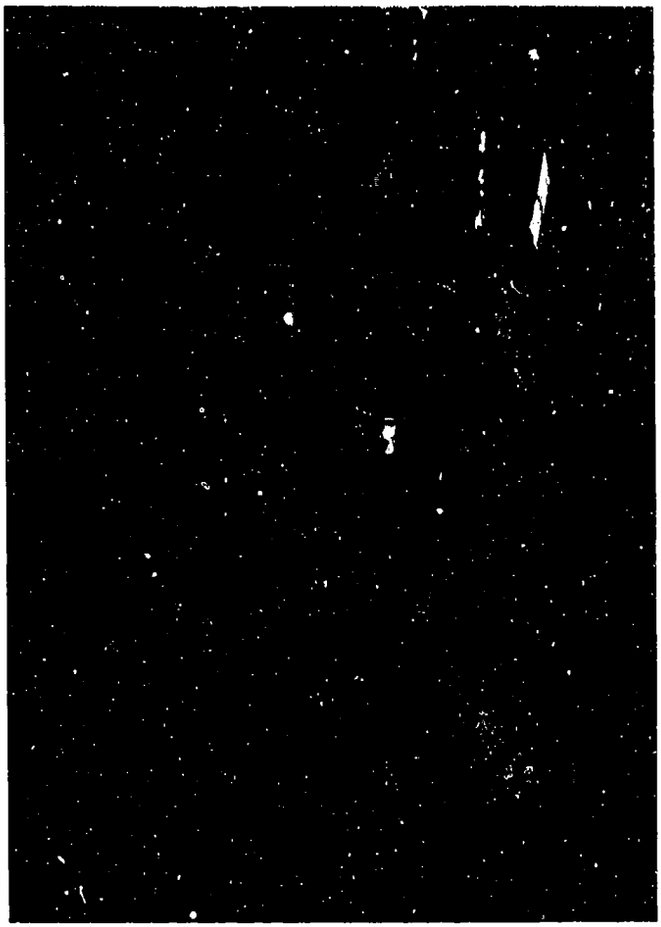
1. Upper left - View across crest of ogee section. View towards left abutment. Note access to intake to abandoned screen chamber.
2. Upper right - View of right spillway retaining wall. Note deterioration of concrete.
3. Lower left - Close-up view of the base of the right concrete retaining wall. Seepage estimated at 1 to 2 gallons per minute.
4. Lower right - View across crest of the spillway. View towards the left abutment.

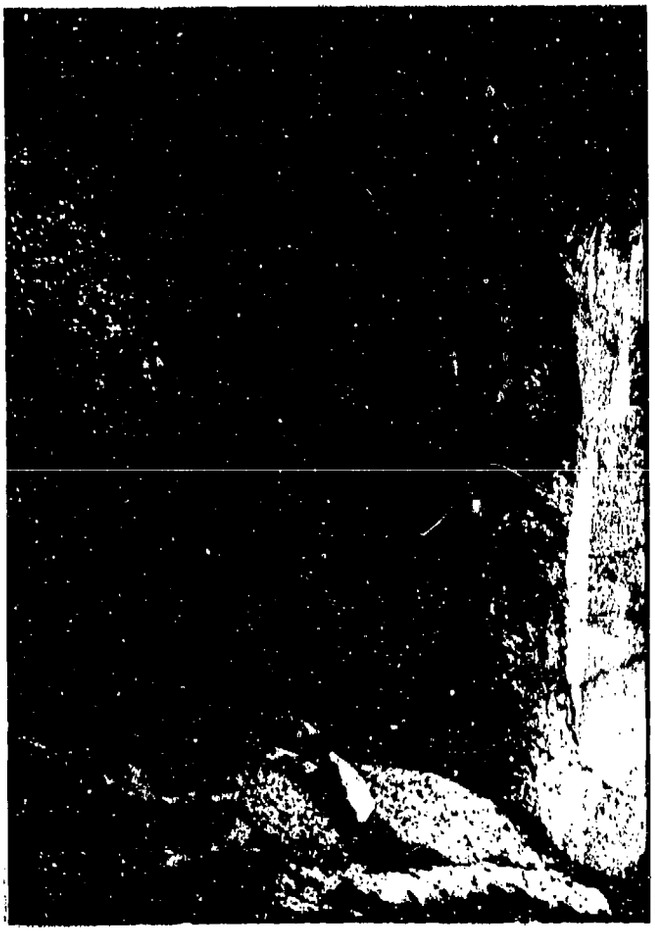
Sheet 1

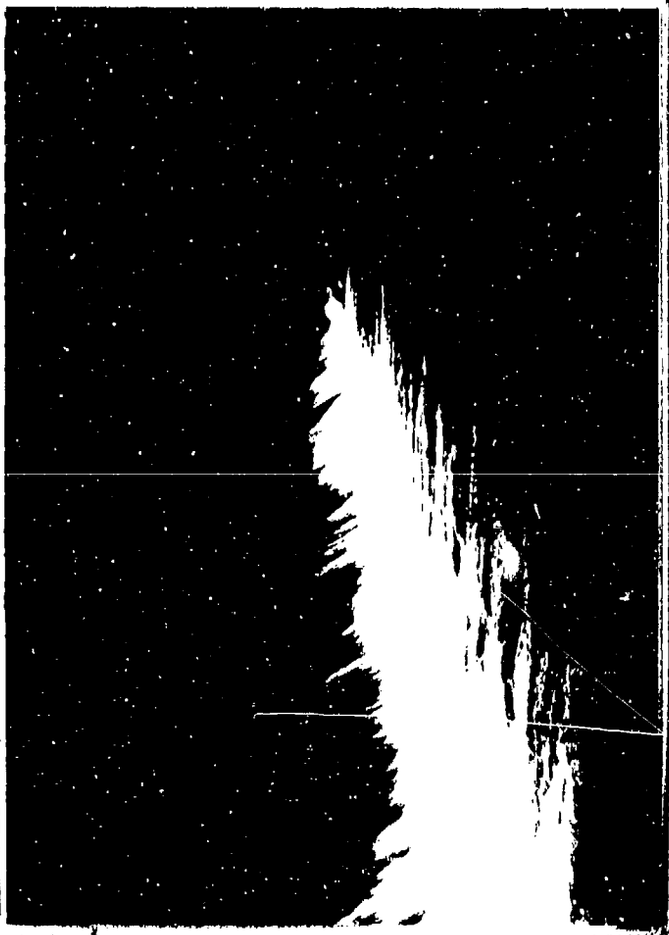
Back

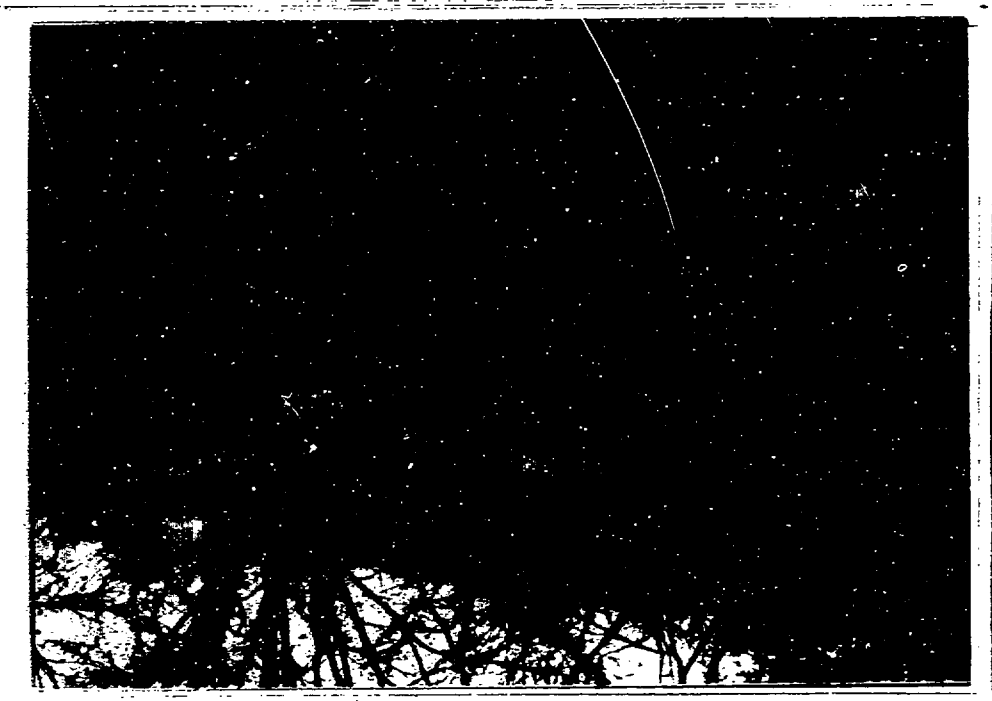
5. Upper left - Downstream exposure viewing towards west bank of the river.
6. Upper right - View of gaging station downstream of dam. Note high watermark on structure.











APPENDIX D
HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology. The dam overtopping and breach analyses were accomplished using the systemized computer program HEC-1 (Dam Safety Investigation), September, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 33" prepared by the U.S. Weather Bureau.

The index rainfall may be reduced from 10% to 20% depending on watershed size by utilization of what is termad the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters their definition and how they were obtained for these analysis.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topgraphic
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

3. Routing. Reservoir routing is accomplished by using Modified Plus routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input, or sufficient dimensions input, and the program will calculate an elevation discharge relationship.

Storage in the pool area is defined by an area - elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping. Using given percentages of the PMF, the computer program will calculate the percentage of the PMF, which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach and Downstream Routing. The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer with given input assumptions) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre and post failure water depths are calculated at locations where cross-sections are input.

HYDROLOGY AND HYDRAULICS ANALYSIS
DATA BASE

NAME OF DAM: Williamsburg Station Dam

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.2 (1.045) = 23.2 inches

STATION	1	2	3
Station Description	Williamsburg Station		
Drainage Area (square miles)	312		
Cumulative Drainage Area (square miles)	312		
Adjustment of PMF for Drainage Area (%)(1)			
6 hours	74		
12 hours	84		
24 hours	95		
48 hours	106		
72 hours	111		
Snyder Hydrograph Parameters			
Zone (2)	21		
Cp (3)	0.55		
Ct (3)	1.5		
L (miles) (4)	30		
Lca (miles) (4)	14		
tp = Ct(LxLca) 0.3 hrs.	9.18		
Spillway Data			
Crest Length (ft)	260		
Freeboard (ft)	12		
Discharge Coefficient	3.8		
Exponent	1.5		

(1) Hydrometeorological Report 40 (Figure 1), U.S. Weather Bureau and U.S. Army Corps of Engineers, 1965.
(2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients (C_p and C_t).
(3) Snyder's Coefficients.
(4) L=Length of longest water course from outlet to basin divide. L_{ca}=Length of water course from outlet to point opposite the centroid of drainage area.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 312 sq.mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 848.0 [199 ac-ft]

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 860.0 [1001 ac-ft]

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 860.0 [top of right spillway retaining wall]

SPILLWAY CREST:

a. Elevation 848.0
b. Type Concrete ogee
c. Width Base of concrete section = 17 feet
d. Length Crest length = 260 feet
e. Location Spillover In river
f. Number and Type of Gates [2] 48" gate valves in ogee section

OUTLET WORKS:

a. Type 48" cast iron pipe
b. Location Right abutment, through earthen embankment section
c. Entrance inverts Unknown
d. Exit inverts Not applicable
e. Emergency drawdown facilities Not applicable

HYDROMETEOROLOGICAL GAUGES:

a. Type None
b. Location None
c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

NOTE: Elevations referred to M.S.L.

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

NAME WILLIAMSBURG STA. DAM
NUMBER PA. 540
SHEET NO. 1 OF 3
BY OTM DATE MAY, 1981

LOSS RATE AND BASE FLOW PARAMETERS

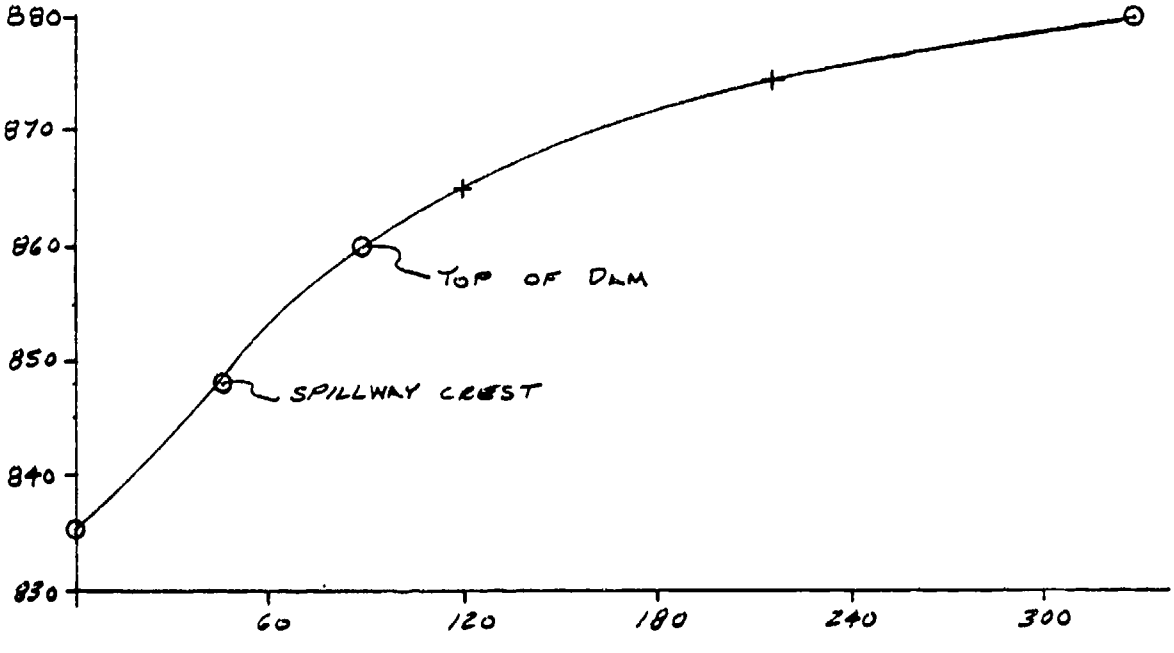
STRTL = 1 INCH
CNSTL = 0.05 IN/HR
STRTQ = 1.5 cfs/mi²
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.0

AS RECOMMENDED BY THE BALTIMORE DISTRICT CORPS OF ENGINEERS.

ELEVATION-AREA-CAPACITY RELATIONSHIPS

FROM U.S.G.S. 7.5-MIN. QUAD, D.E.R. FILES, AND FIELD INSPECTION DATA.

SPILLWAY CREST ELEVATION = 848
AREA AT SPILLWAY CREST (ESTIMATE) = 46 AC
ASSUME ZERO STORAGE AT ELEVATION = 835
AT ELEV. 860, AREA = 90 AC.
AT ELEV. 880, AREA = 330 AC.



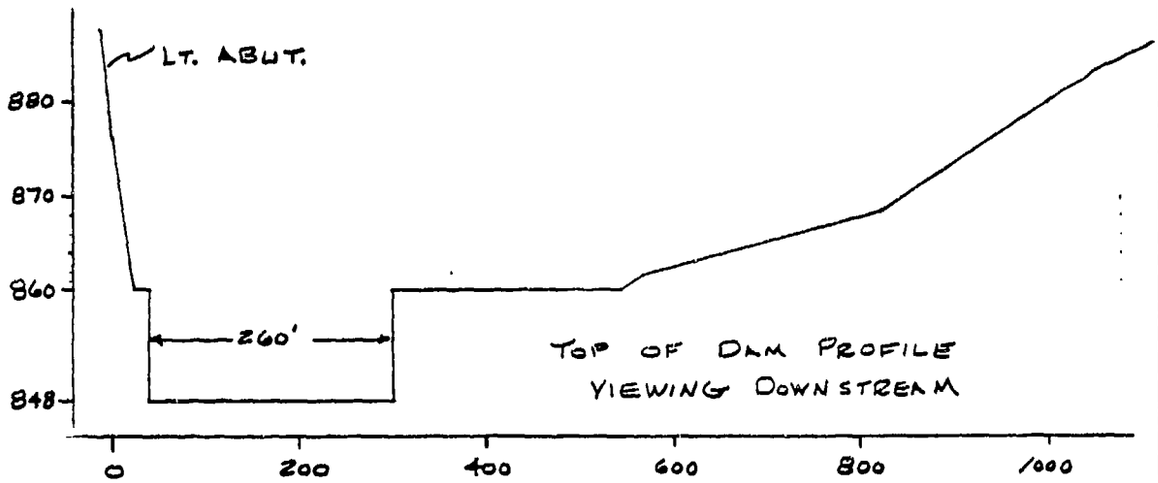
AREA (AC.)	0	46	90	120	217	330
ELEV. (FT)	835	848	860	865	875	880

DISCHARGE RATING

RATING CURVE INCLUDED POTENTIAL OVERTOPPING.

$Q_{1 SPILLWAY} = c\, l\, h^{3/2}$ USE $c = 3.8$ (D.E.R. FILES)
$l = 260$ FT
$h_{MAX} = 860 - 848 = 12$ FT

$Q_{2 OVERTOPPING} = c\, l\, h^{3/2}$ USE $c = 3.1$ (AVG. ABOVE EL. 860)
l VARIES W/ h



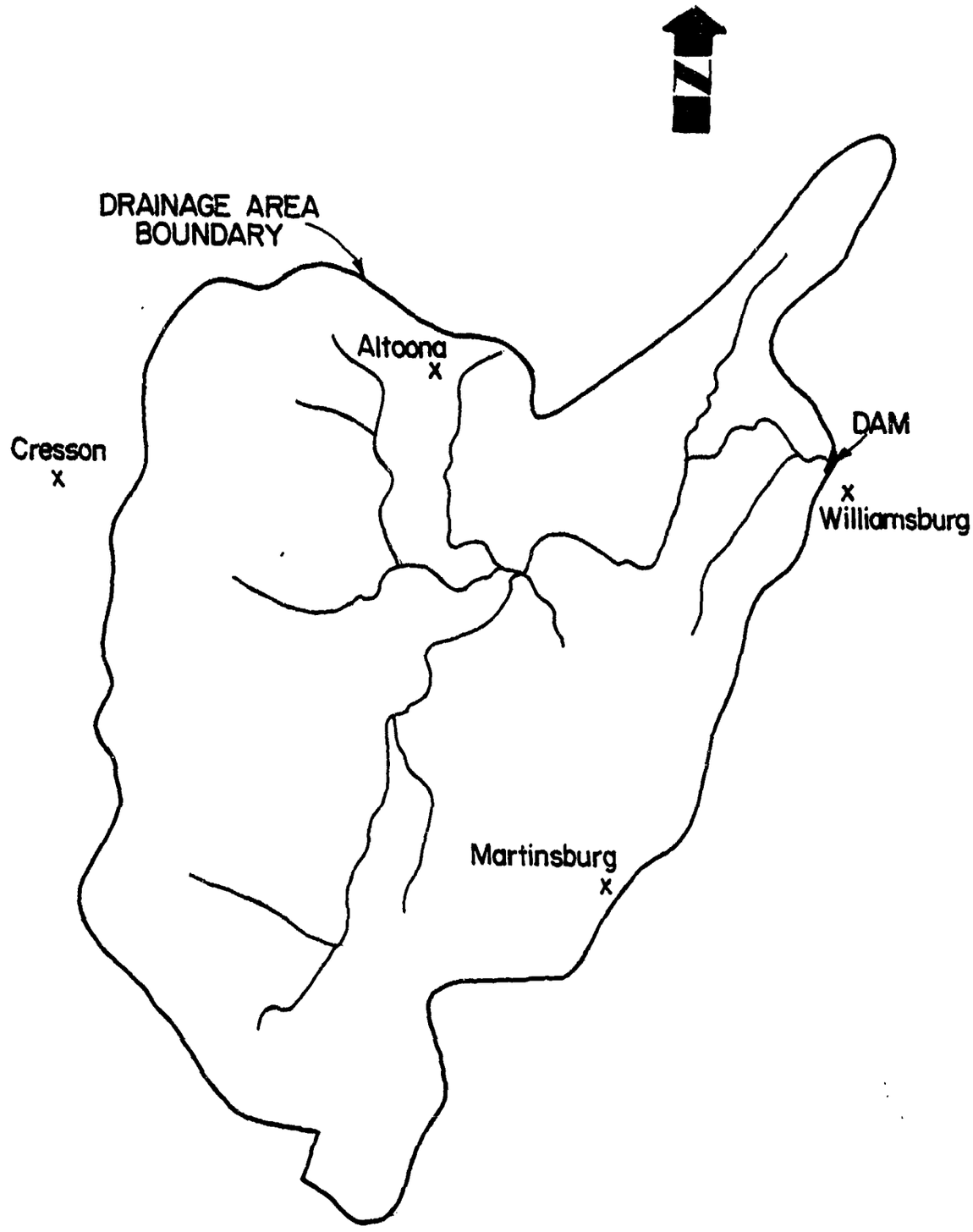
ELEV.	$h_{OVERTOP}$	l
860	0	—
861	1'	540'
862	2'	560'
864	4'	645'
866	6'	720'
868	8'	800'
870	10'	845'

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

NAME
NUMBER PA-540
SHEET NO. 3 OF 3
BY OTM DATE MAY, 1981

ELEV. (FT)	OGEE FLOW h (FT)	OGEE FLOW Q_1 (cfs)	OVERTOPPING h (FT)	OVERTOPPING l (FT)	OVERTOPPING Q_2 (cfs)	DISCHARGE *Q (cfs)
848	0	0				0
849	1	988				990
850	2	2795				2790
851	3	5134				5130
852	4	7904				7900
853	5	11046				11050
854	6	14521				14520
855	7	18298				18300
856	8	22356				22360
858	10	31243				31240
860	12	41070				41070
861			1	540	1674	42740
862			2	560	4910	45980
864			4	645	15996	57070
866			6	720	32804	73870
868			8	800	56116	97190
870			10	845	82836	123910

* Q ROUNDED TO NEAREST 10 cfs



WILLIAMSBURG STATION DAM

DRAINAGE AREA MAP

SCALE: 1"= 4 MILES

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION  JULY 1978
  LAST MODIFICATION  01 APR 80
**********
```

```
     1          A1    ANALYSIS OF DAM OVERTOPPING USING RATIOS OF THE PMF
     2          A2    HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF WILLIAMSBURG STATION DAM
     3          A3    RATIOS OF THE PMF ROUTED THROUGH THE RESERVOIR (PA-540)
     4          B   144     0      30      0       0       0       0       0      -4       0
     5          B1    5
     6          J     1     5       1
     7          J1  .2    .4      .5     .7       1
     8          K     0     1                                      1
     9          K1      INFLOW                                                          1
    10          M     1     1     312                                1
    11          P           23.2    74      84      95     106     111
    12          T                                                  1.0     0.05
    13          W   9.18    0.55
    14          X  -1.5    -.05    2.0
    15          K     1     2                                      1
    16          K1      ROUTE
    17          Y                                    1       1                 -848     -1
    18          Y1    1
    19          Y4  846     849     850     851     852     853     854     855     856     858
    20          Y4  860     861     862     864     866     868     870
    21          Y5    0     990    2790    5130    7900   11050   14520   18300   22360   31240
    22          Y5 41070   42740   45980   57070   73870   97190  123910
    23          $A    0      66      90     120     217     330
    24          $E  835     848     860     865     875     880
    25          $S  848
    26          $D  860
    27          K    99
```

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 01 APR 80
****

RUN DATE= 81/05/27.
TIME= 07.10.19.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF THE PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF WILLIAMSBURG STATION DAM
RATIOS OF THE PMF ROUTED THROUGH THE RESERVOIR (PA-540)

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
144	0	30	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIOS= .20 .40 .50 .70 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	312.00	0.00	312.00	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.20	74.00	84.00	95.00	106.00	111.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 9.18 CP= .55 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 9.22 HOURS, CP= .55 VOL= .98

151.	571.	1178.	1906.	2723.	3610.	4554.	5545.	6574.	7631.
8654.	9573.	10369.	11042.	11591.	12013.	12298.	12435.	12392.	12076.
11565.	11042.	10542.	10065.	9610.	9175.	8760.	8364.	7985.	7624.
7279.	6949.	6635.	6335.	6048.	5774.	5513.	5264.	5026.	4798.

4581.	4374.	4176.	3987.	3806.	3634.	3470.	3313.	3163.	3020.
2883.	2753.	2628.	2509.	2396.	2287.	2184.	2085.	1991.	1901.
1815.	1732.	1654.	1579.	1508.	1439.	1374.	1312.	1253.	1196.
1142.	1090.	1041.	994.	949.	906.	865.	826.	788.	753.
719.	686.	655.	626.	597.	570.	544.	520.	496.	474.
452.	432.	412.	394.	376.	359.	343.	327.	312.	298.

END-OF-PERIOD FLOW

MO.	DA	HR.	MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.	DA	HR.	MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
													SUM	25.75	22.65	3.10	8321721.
														(654.)	(575.)	(79.)	(********)

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-848.	-1

D-12

STAGE	848.00	849.00	850.00	851.00	852.00	853.00	854.00	855.00	856.00
858.00									
	860.00	861.00	862.00	864.00	866.00	868.00	870.00		
FLOW	0.00	990.00	2790.00	5130.00	7900.00	11050.00	14520.00	18300.00	22360.00
31240.00									
	41070.00	42740.00	45980.00	57070.00	73870.00	97190.00	123910.00		
SURFACE AREA=	0.	46.	90.	120.	217.	330.			
CAPACITY=	0.	199.	1001.	1524.	3185.	4543.			
ELEVATION=	835.	848.	860.	865.	875.	880.			

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
848.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
860.0	0.0	0.0	0.

PEAK OUTFLOW IS 44653, AT TIME 48.50 HOURS

PEAK OUTFLOW IS 89487, AT TIME 48.50 HOURS

PEAK OUTFLOW IS 111858, AT TIME 48.50 HOURS

PEAK OUTFLOW IS 156597, AT TIME 48.50 HOURS

PEAK OUTFLOW IS 223830, AT TIME 48.50 HOURS

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .20	RATIO 2 .40	RATIO 3 .50	RATIO 4 .70	RATIO 5 1.00
HYDROGRAPH AT	1	312.00 (808.08)	1	44741. (1266.92)	89481. (2533.89)	111852. (3167.29)	156593. (4434.21)	223704. (6334.58)
ROUTED TO	2	312.00 (808.08)	1	44653. (1264.43)	89487. (2533.98)	111858. (3167.47)	156597. (4434.34)	223638. (6332.73)

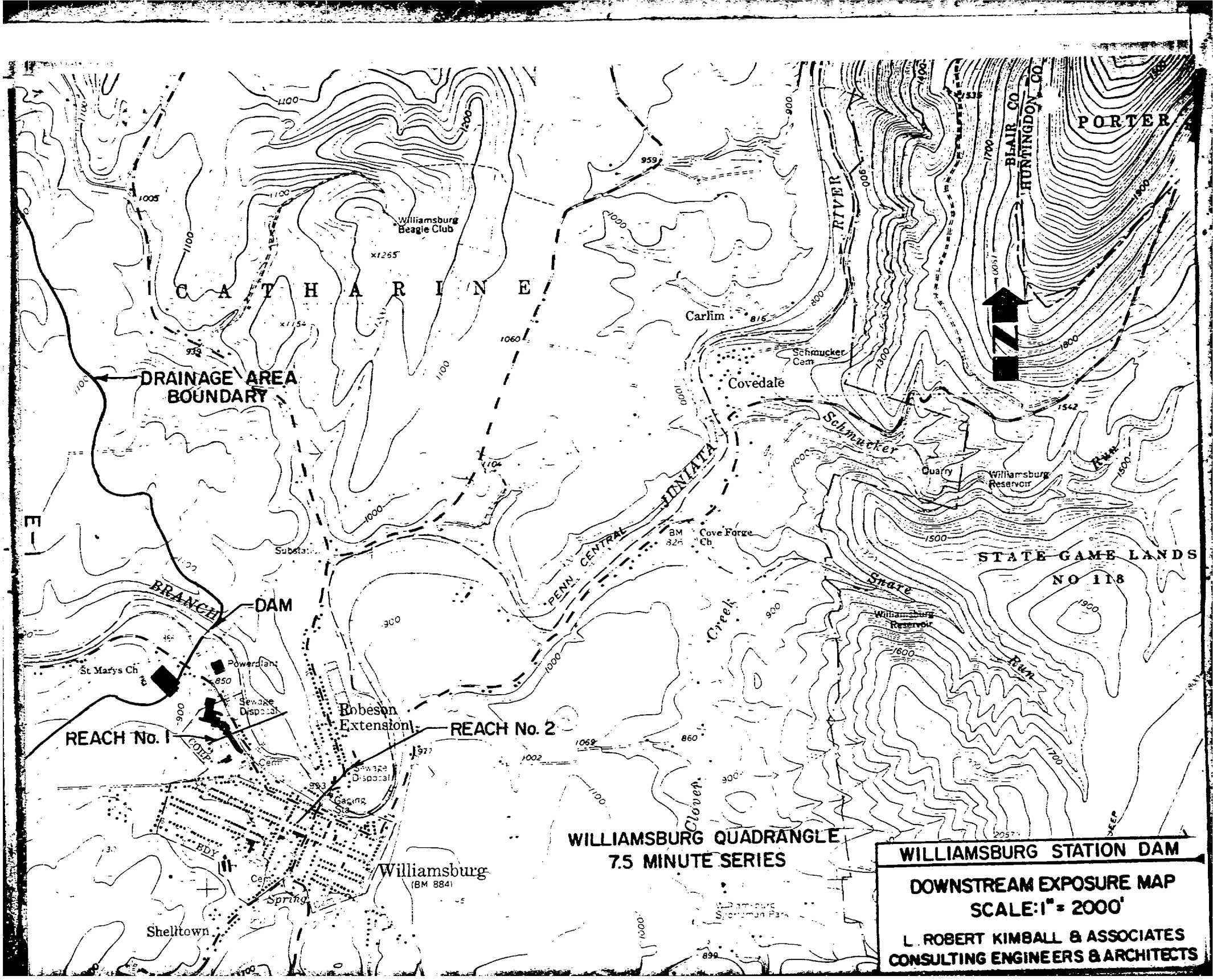
SUMMARY OF DAM SAFETY ANALYSIS

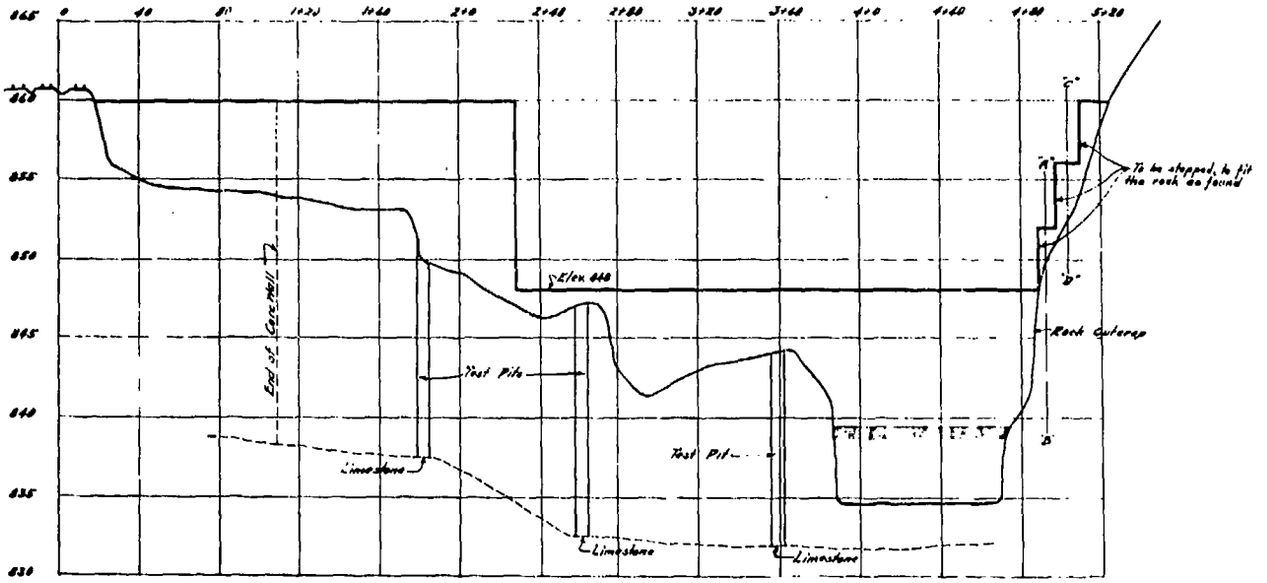
PLAN 1 ****************

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	848.00	848.00	860.00
STORAGE	199.	199.	1001.
OUTFLOW	0.	0.	41070.

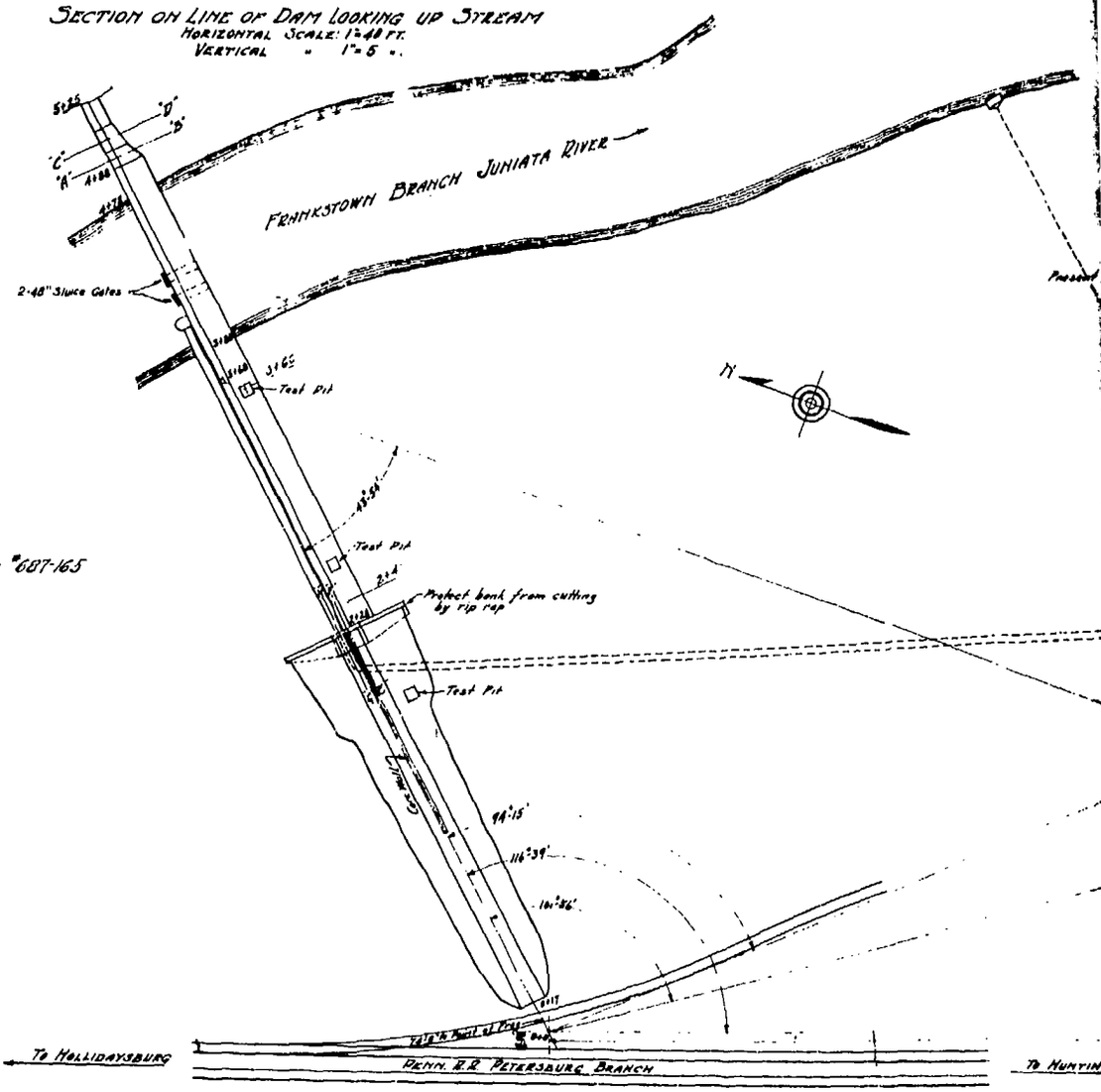
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	861.59	1.59	1151.	44653.	5.00	48.50	0.00
.40	867.34	7.34	1828.	89487.	17.00	48.50	0.00
.50	869.10	9.10	2088.	111858.	20.00	48.50	0.00
.70	872.45	12.45	2667.	156597.	24.50	48.50	0.00
1.00	877.46	17.46	3784.	223658.	31.50	48.50	0.00

APPENDIX E
DRAWINGS

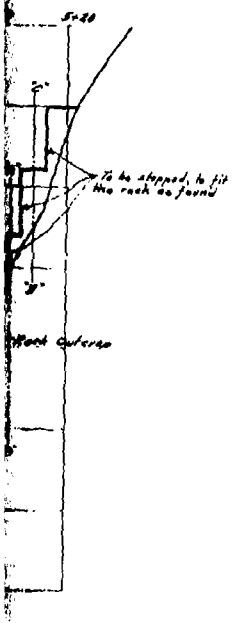

DRAINAGE AREA BOUNDARY
REACH No. 1
REACH No. 2
DAM
BRANCH
Robeson Extension
Williamsburg Beagle Club
Carlim
Covedale
Schmucker Cem
Schmucker Run
Quarry
Williamsburg Reservoir
Cove Forge Ch
PENN CENTRAL
JUNIATA
RIVER
BLAIR CO
HUNTINGDON CO
PORTER
STATE GAME LANDS NO 118
Snare Creek
Clover Run
St Marys Ch
Powerplant
Sewage Disposal
Gaging Sta
Williamsburg (BM 884)
Spring
Shelltown
WILLIAMSBURG QUADRANGLE
7.5 MINUTE SERIES
WILLIAMSBURG STATION DAM
DOWNSTREAM EXPOSURE MAP
SCALE: 1" = 2000'
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

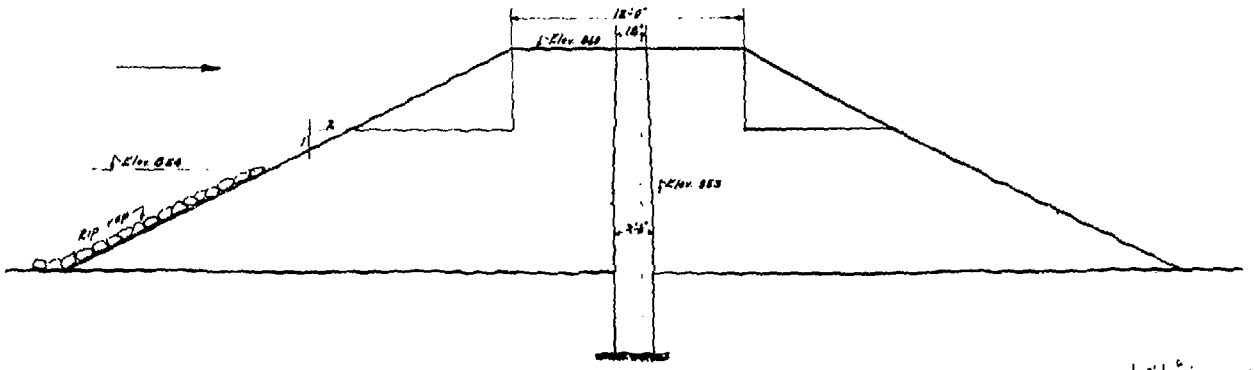


SECTION ON LINE OF DAM LOOKING UP STREAM
HORIZONTAL SCALE: 1"=40 FT.
VERTICAL " 1"=5 "

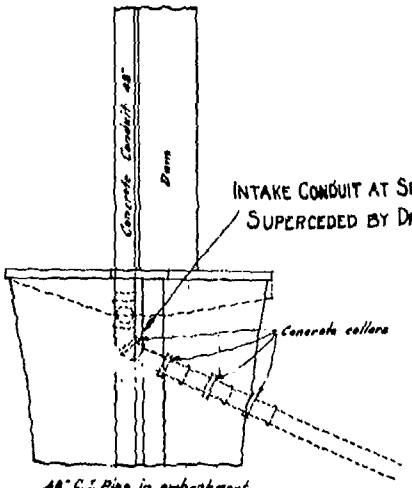


NOTE: FOR SECTIONS, SEE PLAN #687-165



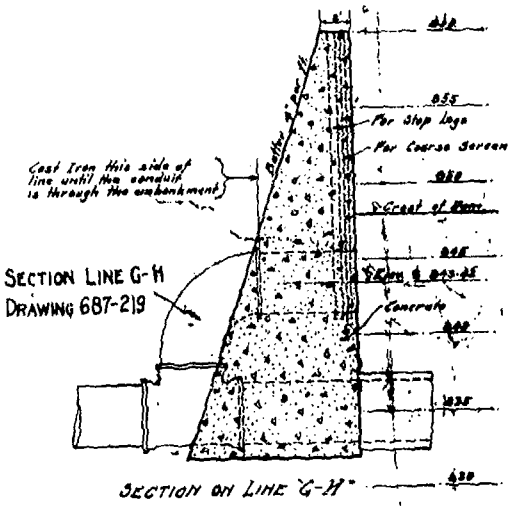


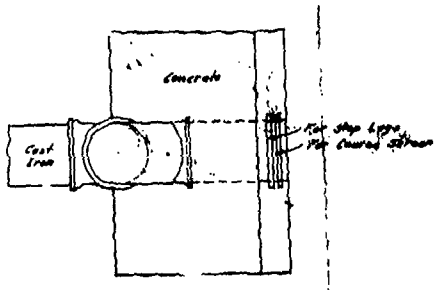
TYPICAL EMBANKMENT SECTION
SCALE 4'=1"



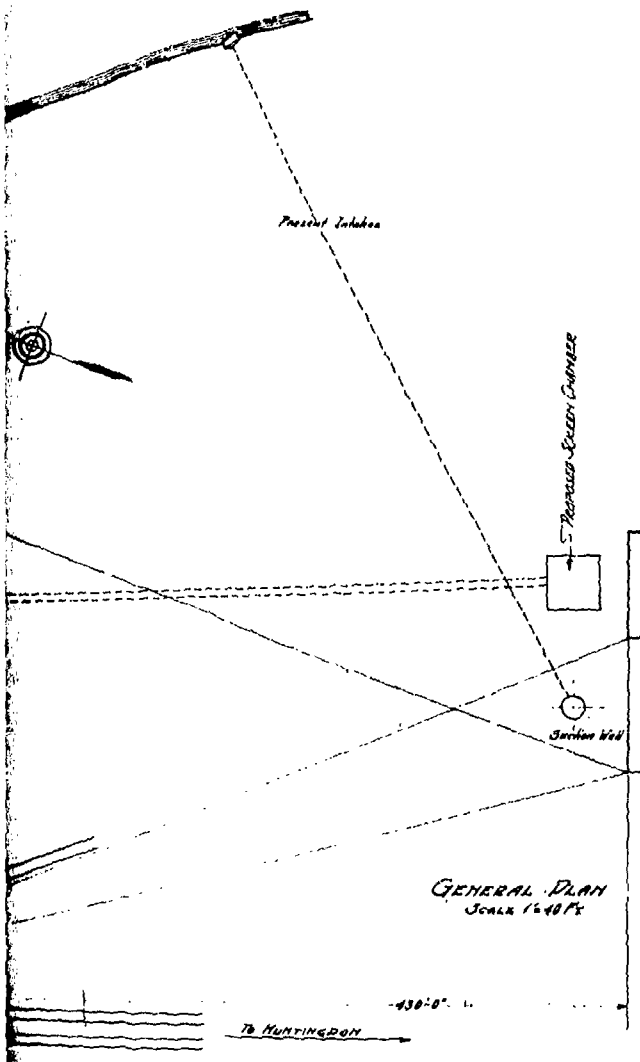
PLAN OF CONDUIT IN EMBANKMENT
Scale:-1"=10'

INTAKE CONDUIT AT SECTION LINE G-H
SUPERCEDED BY DRAWING 687-219





BRANCH INTAKE IN RETAINING WALL AT END OF SPILLWAY

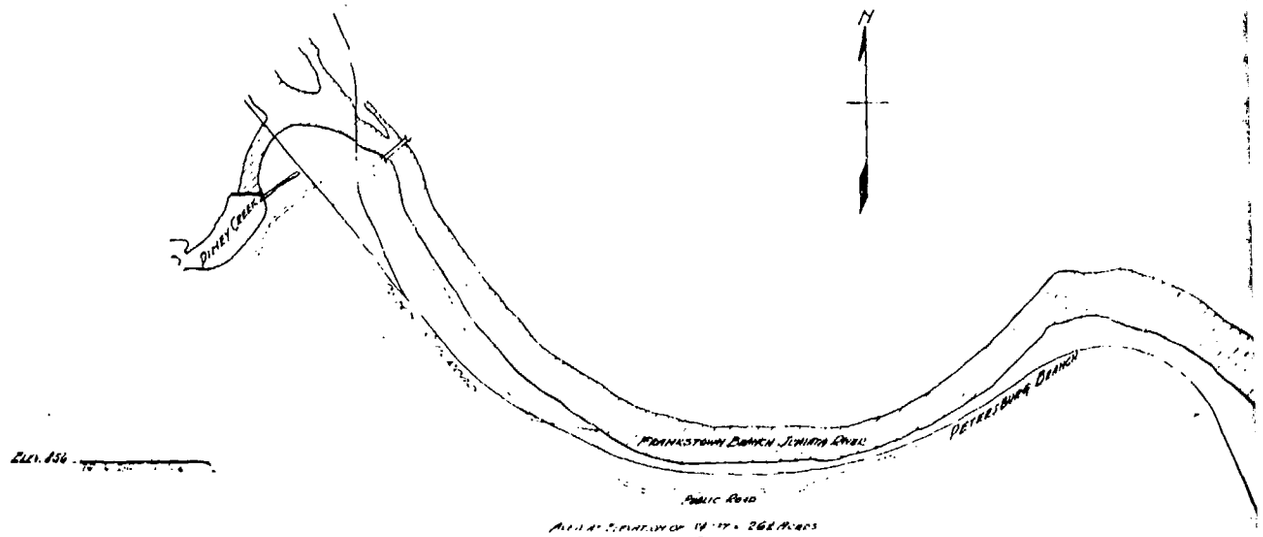


GENERAL PLAN
SCALE 1"=40 Ft.

PLAN AND SECTIONS
PROPOSED DAM FOR CONDENSER WATER
WILLIAMSBURG POWER PLANT
PENN CENTRAL POWER AND TRANSMISSION CO.
[illegible] & MACKENZIE
ENGINEERS [illegible]

E 2

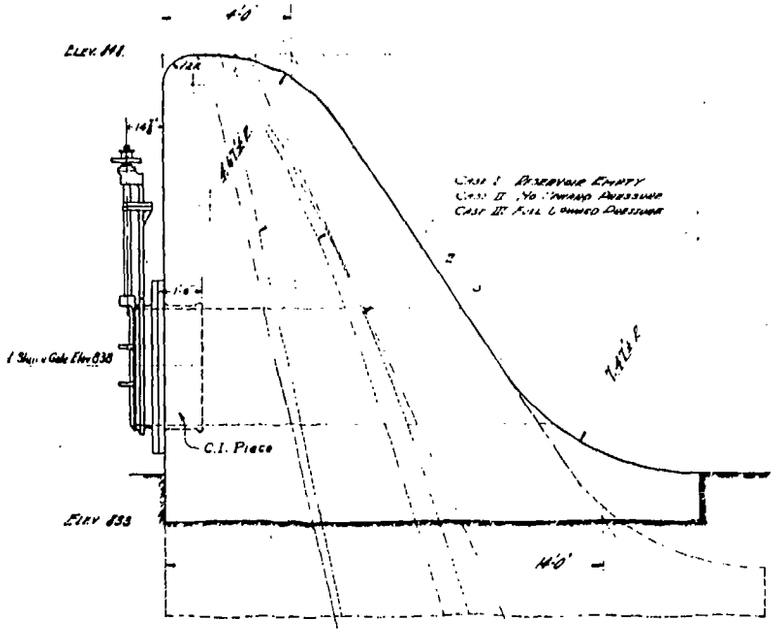
1 2



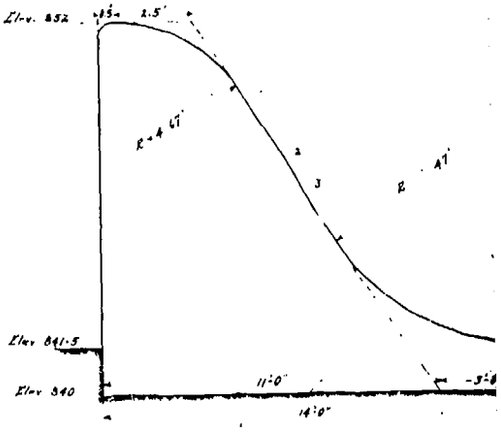
AREA AT ELEVATION OF 14'-17' = 262 ACRES
CAPACITY = 26000000 GALLONS

SCALE 1" = 1/4 MILE

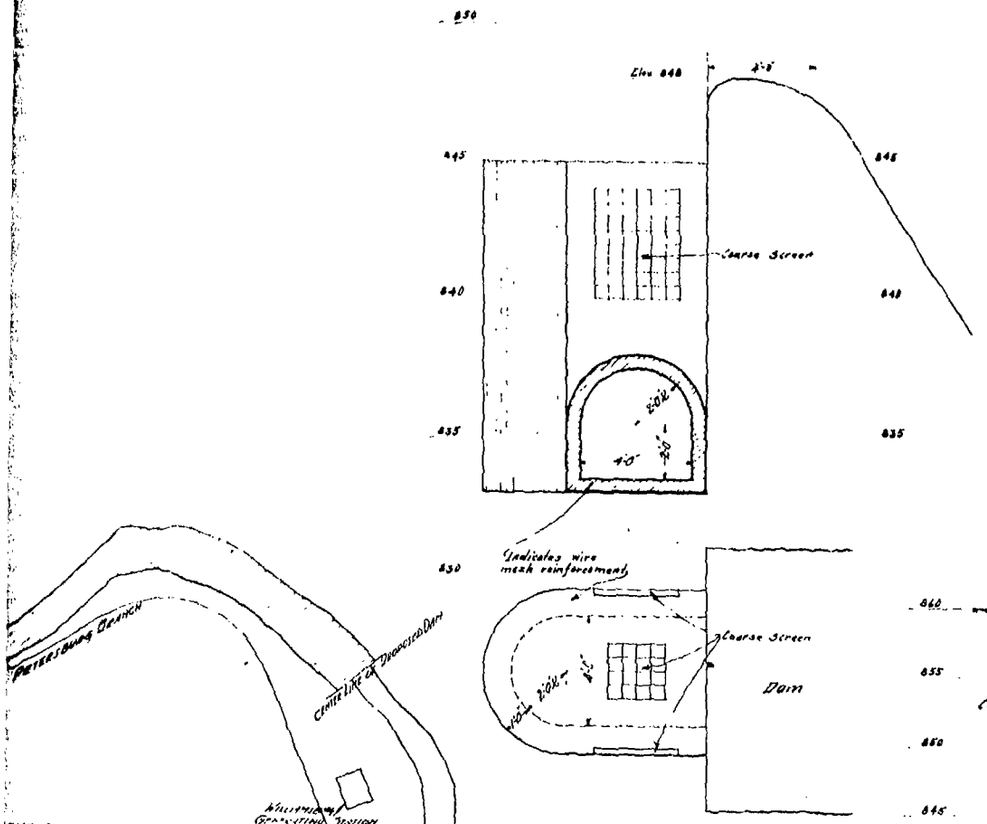
PLAN OF STORAGE RESERVOIR



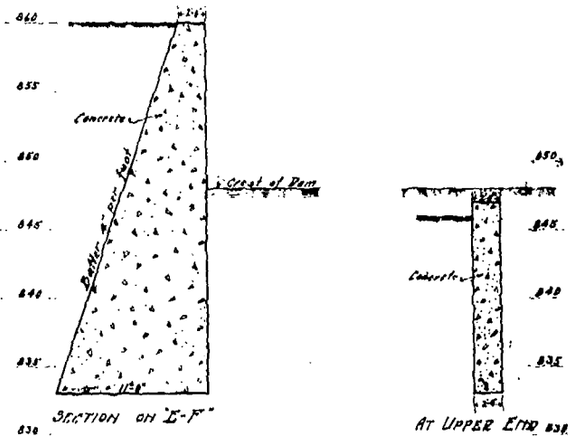
MAIN SECTION OF DAM



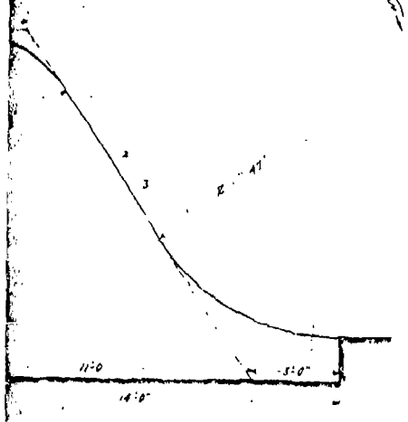
SECTION ON "A-B"



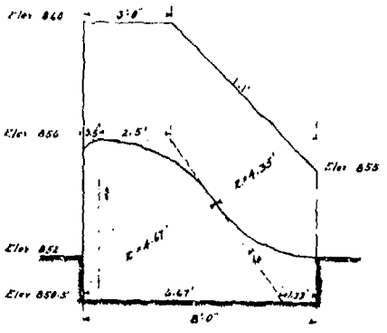
INTAKE IN RIVER



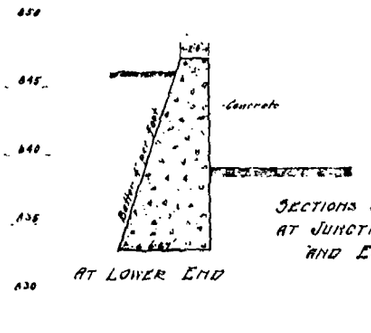
SECTION ON "E-F"



SECTION ON "A-B"



SECTION ON "C-D"



SECTIONS OF RETAINING WALL AT JUNCTION OF SPILLWAY AND EMBANKMENT

PLAN OF STORAGE RESERVOIR AND SECTION OF DAM
PROPOSED DAM FOR CONDENSER WATER
WILLIAMSBURG POWER PLANT
PENN CENTRAL POWER AND TRANSMISSION CO.

DAY & ZIMMERMANN
ENGINEERS, PHILADELPHIA, PA.

REVISIONS				
DESCRIPTION	DATE	DESCRIPTION	DATE	DRAWN BY ... TRACED BY ... CHECKED BY ... APPROVED BY ...
Sluice Gate Added	1-10-20			SCALE ... DATE ...
				DATE OF THIS PRINT ...

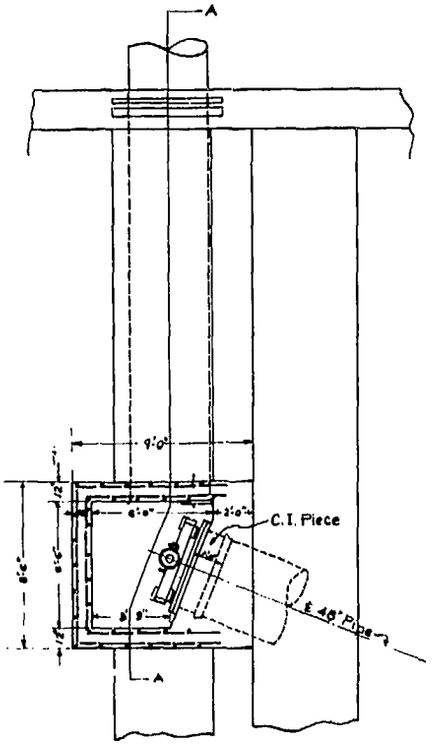
157-165

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

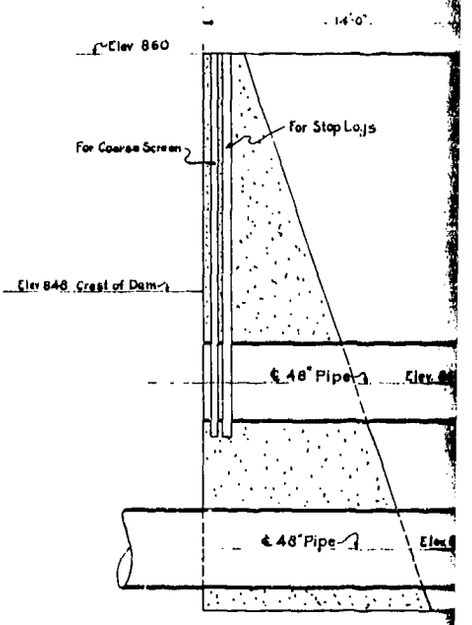
E 3

1

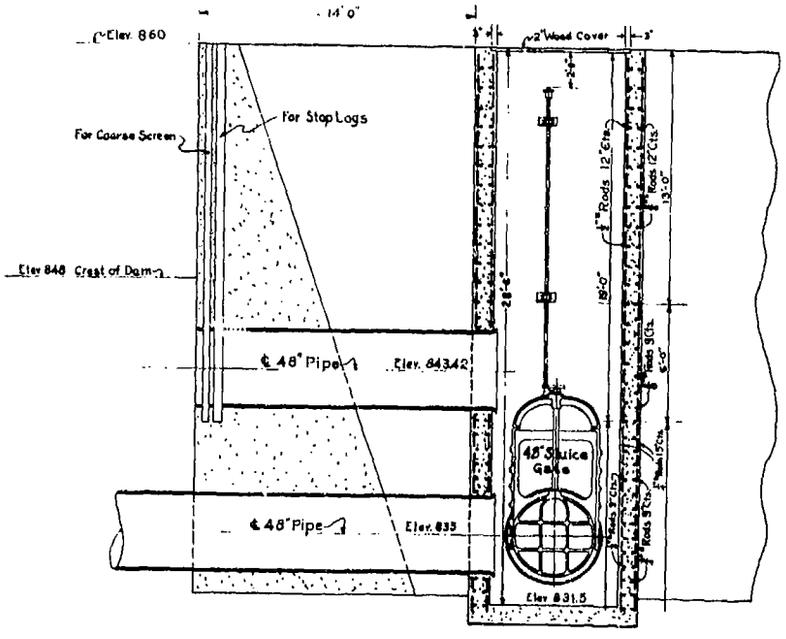
2



PLAN OF SLUICE GATE
WITH COVER REMOVED



SECTION



SECTION A-A

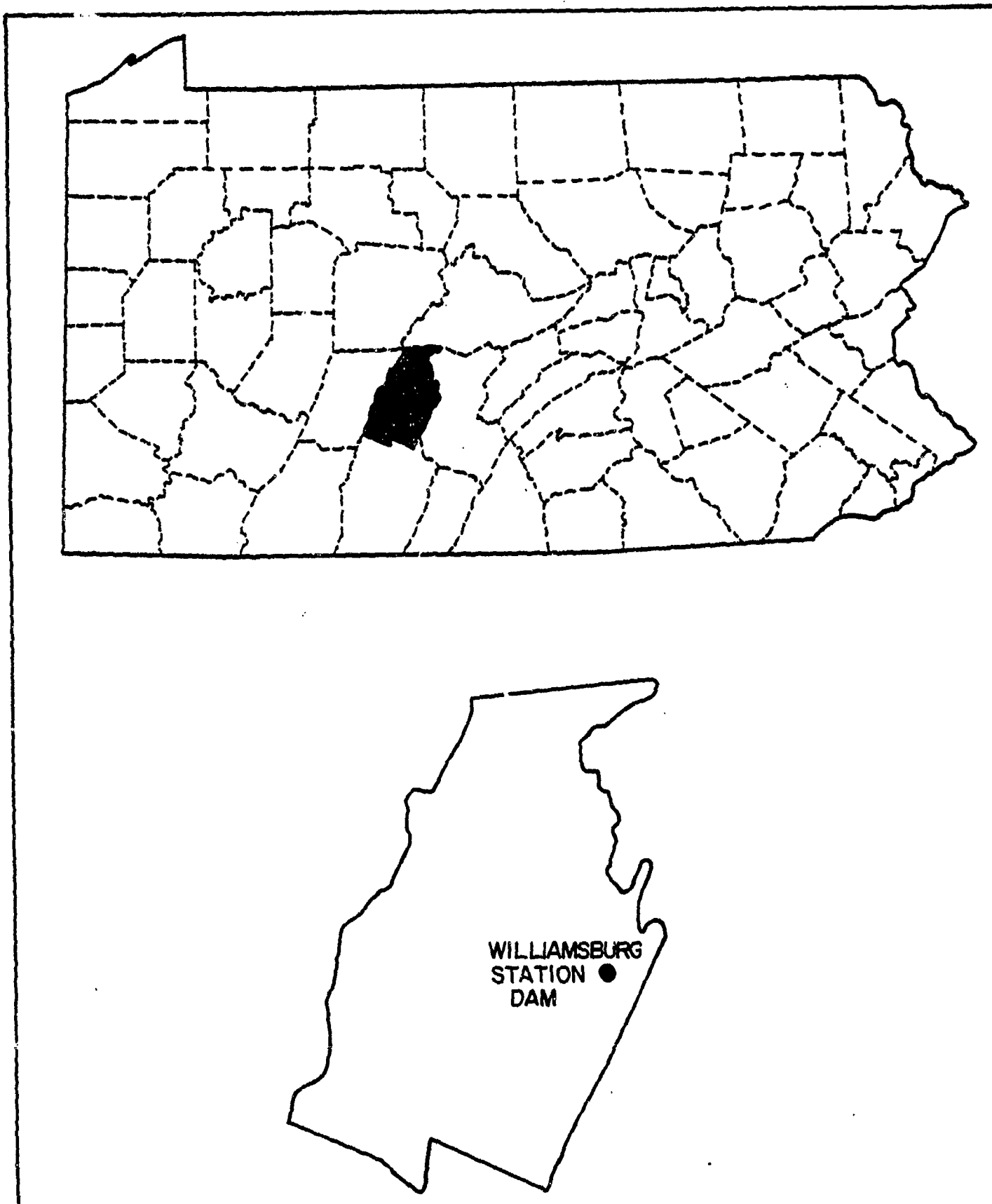
48" SLUICE GATE IN INTAKE LINE FROM DAM
AT SECTION LINE G-H
WILLIAMSBURG POWER PLANT
PENN CENTRAL POWER AND TRANMISSION CO.

DAY & ZIMMERMANN, Inc.
ENGINEERS, PHILADELPHIA, PA.

REVISIONS					
DESCRIPTION	DATE	DESCRIPTION	DATE	DRAWN BY B.J. TRACED BY E.K. CHECKED BY ___ APP'D BY ___	
				SCALE 1"=1' DATE 1-12-70	687 219
				DATE OF THIS PRINT [redacted]	PER ORDER 1513

E 4

2



SITE LOCATION MAP
BLAIR COUNTY, PENNSYLVANIA

E-5

APPENDIX F
GEOLOGY

General Geology

The Williamsburg Station Dam is located in the Appalachian Mountain Section of the Valley and Ridge Province. This section is separated by the Allegheny Front from the Allegheny Mountain Section to the west. The section is composed of large amplitude folds and numerous faults. The Palezoic rocks have moved northwestward on a deep regional decallement located at the top of the Lower Cambrian rocks. Greater deformation in the valley and Ridge Province than the Plateau Province resulted from greater movement of the earth. The alternate succession of narrow ridges and broad or narrow valleys trends generally northeast. The two major structural features in this region are the Scotch Valley Syncline to the west of the site and the Bridge Anticline to the east of the site. Several minor folds exist between these structures. The Williamsburg Station Dam lies southeast of a minor anticlinal fold which axis strikes to the northeast as the strata subsequently do. The dip of rocks is about 60° to the southeast locally. Major faults are to the east and west of the dam site. Both faults are northwest directed thrust faults caused by compressional forces from the southeast. These faults are the West Henrietta Fault to the west and the Williamsburg Fault to the east. The dam is located on the upthrown side of the West Henrietta Fault.

The rock underlying the dam belongs to the Fatesburg Formation of Upper Cambrian Age. It consists of thick bedded steel-blue coarsely crystalline dolomite with many layers of sandstone or quartzite. It also contains a few beds of olitic chert. Gatesburg has a thickness range of 1600-1750 feet where it is fully exposed. It disconformably overlies the Warrior limestone and extends to the Mines dolomite above.

GEOLOGIC MAP OF THE AREA AROUND THE WILLIAMSBURG STATION DAM

SCALE: 1:250,000

CAMBRIAN
CENTRAL PENNSYLVANIA

Mines Formation
Bluish gray crystalline dolomite; largely oolitic with much oolitic chert.

Gatesburg Formation
Bluish gray, coarse crystalline dolomite with many sandstone interbeds, cryptozoan reefs common.

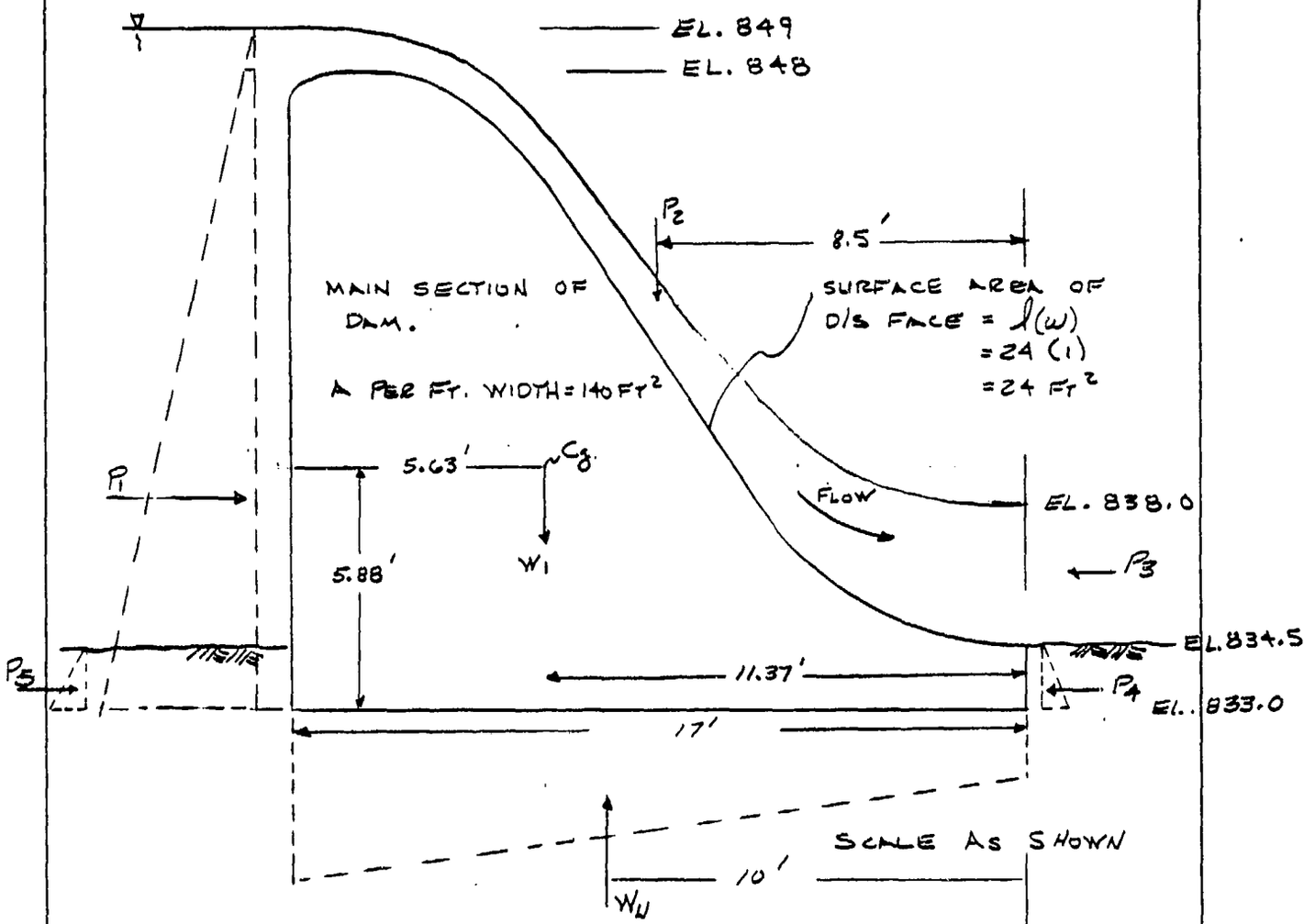
Warrior Formation
Bluish gray, fine grained dolomite with shaly partings

Pleasant Hill Formation
Dark gray, thick bedded limestone and thin bedded, shaly limestone.

APPENDIX G
STABILITY ANALYSIS

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

NAME
NUMBER R2-540
SHEET NO. 1 OF
BY OTM DATE MAY, 1981



ASSUMPTIONS:

1. UNIT WT. OF CONCRETE GRAVITY CONSTRUCTION MATR'L = 140 PCF
2. NEGLECT VELOCITY HEAD.
3. UNIT WT. SATURATED SILT = 120 PCF
4. STRUCTURE FOUNDED ON ROCK, $f = 0.71$, $\tan^{-1} = 35°$ (DER FILE)
5. ANGLE OF INTERNAL FRICTION FOR SILT = 30°
6. ASSUME TAILWATER AT 838.0.

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

NAME
NUMBER PA-540
SHEET NO. 2 OF
BY OTM DATE MAY, 1981

WATER FORCE:

$P_1 = (15FT)^2 (1FT)(62.4\ LBS/FT^3)/2 = 7{,}020\ LBS$

$P_2 = (24FT)(1FT)(1FT)(62.4\ LBS/FT^3) = 1{,}498\ LBS$

$P_3 = (5FT)^2(1FT)(62.4\ LBS/FT^3)/2 = 780\ LBS$

SOIL FORCE:

$$P_4 = \left(\frac{(120-62.4)(1.5)^2}{2}\right)\left(\frac{1+SIN\ 30}{1-SIN\ 30}\right) = 194\ LBS$$

$$P_5 = \left(\frac{(120-62.4)(1.5)^2}{2}\right)\left(\frac{1-SIN\ 30}{1+SIN\ 30}\right) = 22\ LBS$$

WEIGHT OF DAM:

$W_1 = (V)(\gamma)$
$= (A \times L)(\gamma)$
$= [(140FT^2)(1FT)](140\ LBS/FT^3)$
$= 19{,}600\ LBS$

UPLIFT FORCE:

$W_U = C\,\gamma_w [h_2 + 1/2\,S(h_1 - h_2)] \cdot A$ WHERE $C = 2/3$, $S = 1$

$= 0.67(62.4)[5 + 1/2(1)(16-5)](17)$

$= 41.8[10.5]17 = 7{,}461\ LBS$

FROM: "ENGINEERING FOR DAMS" 1945
BY CREAGER, JUSTIN, & HINDS
Pg. 267

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

NAME
NUMBER PA-540
SHEET NO. 3 OF
BY OTM DATE MAY, 1981

STABILITY AGAINST SLIDING

$$F.S. = \frac{(19,600 + 1,498 - 7,461)(0.71) + (780+194)}{7,020 + 22}$$

$$= \frac{10,656}{7,044} = 1.5 \quad \text{ok!}$$

STABILITY AGAINST OVERTURNING ABOUT DOWNSTREAM TOE

OVERTURING MOMENT (M_o)

$$M_o = P_1(5.0) + P_5(0.5) + W_u(10.0)$$
$$= 7,020(5.0) + 22(0.5) + 7,461(10.0)$$
$$= 109,700 \text{ Ft. LBS}$$

RIGHTING MOMENT (M_R)

$$M_R = W_1(11.4) + P_2(8.5) + P_3(1.7) + P_4(0.5)$$
$$= 19,600(11.4) + 1,498(8.5) + 780(1.7) + 194(0.5)$$
$$= 237,600 \text{ Ft. LBS}$$

$$F.S. = \frac{M_R}{M_o} = \frac{237,600}{109,700} = 2.2 \quad \text{ok!}$$

$\Sigma V = W_1 + P_2 - W_u = 13,637 \downarrow$
$\Sigma M = 237,600 - 109,700 = 127,900 \circlearrowright$

$\Sigma M / \Sigma V = 9.38$ FT.

$1/3(17) = 5.67$ FT $<$ 9.38 FT $\therefore$ RESULTANT FALLS WITHIN MIDDLE THIRD.